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Now that extensive investigation has been carried out on the coastal midden sites of the north and south coasts of New South Wales (see references), it is timely to record those of the central coast. A survey between Budgewoi and Avoca has already received a brief report (Stockton 1972). In 1975-6 this survey was extended north and south to include all the coastline between Lake Macquarie and Broken Bay. Between Broken Bay and Port Hacking urban development renders similar survey impossible, while published material for excavations in the Sydney area and further south is quite considerable. However, for comparative purposes, I have looked at sites in North Harbour (Port Jackson) and the Royal National Park. All these sites can be mentioned only briefly here, but individual site reports are held by the Australian Institute of Aboriginal Studies and the National Parks and Wildlife Service. Here I wish to make only general observations, particularly in reference to the northern and southern extensions of the survey.

Siting

In the north the coastline is very rugged with few breaks in the cliffs, which are composed of the coarse conglomerates of the Newcastle coal measures, with notable seams of coal and chert exposed in the seaward face, frequently intruded by dykes and faultlines. The cliffs generally drop straight into deep open sea, and the rock platforms, which are characteristic of the coastline to the south, are here fewer and smaller, and apparently less hospitable to shell fish. The breaks in the cliff-line give way to inlets containing sandy or pebbly beaches.

Budgewoi and Tuggerah Beaches are long, exposed stretches of sand, forming barriers to Munmorah and Tuggerah Lakes. Interrupting this sand barrier at Norah Head and continuing south of The Entrance are low outcrops of Narrabeen group sandstone topped by 'high sandhills, some recent and scarcely stable, others of compact grey sand reaching up to 450 ft in the Wamberal-Bateau Bay area' (Stockton 1972:20). The coastline alternates regularly between beaches and small headlands, with intertidal reefs and platforms extending from the foot of the headlands.

The southern end of the survey area develops into a rugged range of Narrabeen group sandstone, capped by Hawkesbury sandstone reaching a height of 150 m at Mt Bouddi, with dense vegetation ranging from rain-forest to heath on exposed headlands. With the undercutting of the Hawkesbury sandstone by the erosion of the Narrabeen shales, the land falls away sharply to seaward, terminating in an almost continuous line of cliffs above a narrow rocky talus at water level. As in the north, the rugged coastline is deeply indented with inlets containing sandy or pebbly beaches.

This 79 km coastline has at least 40 sites. This is density of .51 sites/km, which compares with site density of .72 for the south coast (or 1/km for the short stretches of comparable sandstone coastline) (Sullivan 1976:61) or .85 for the Victorian coast (ranging from .2 for Zone 9 to 1.43 for Zones 11 and 14) (Coutts *et al.* Table 16). See Table

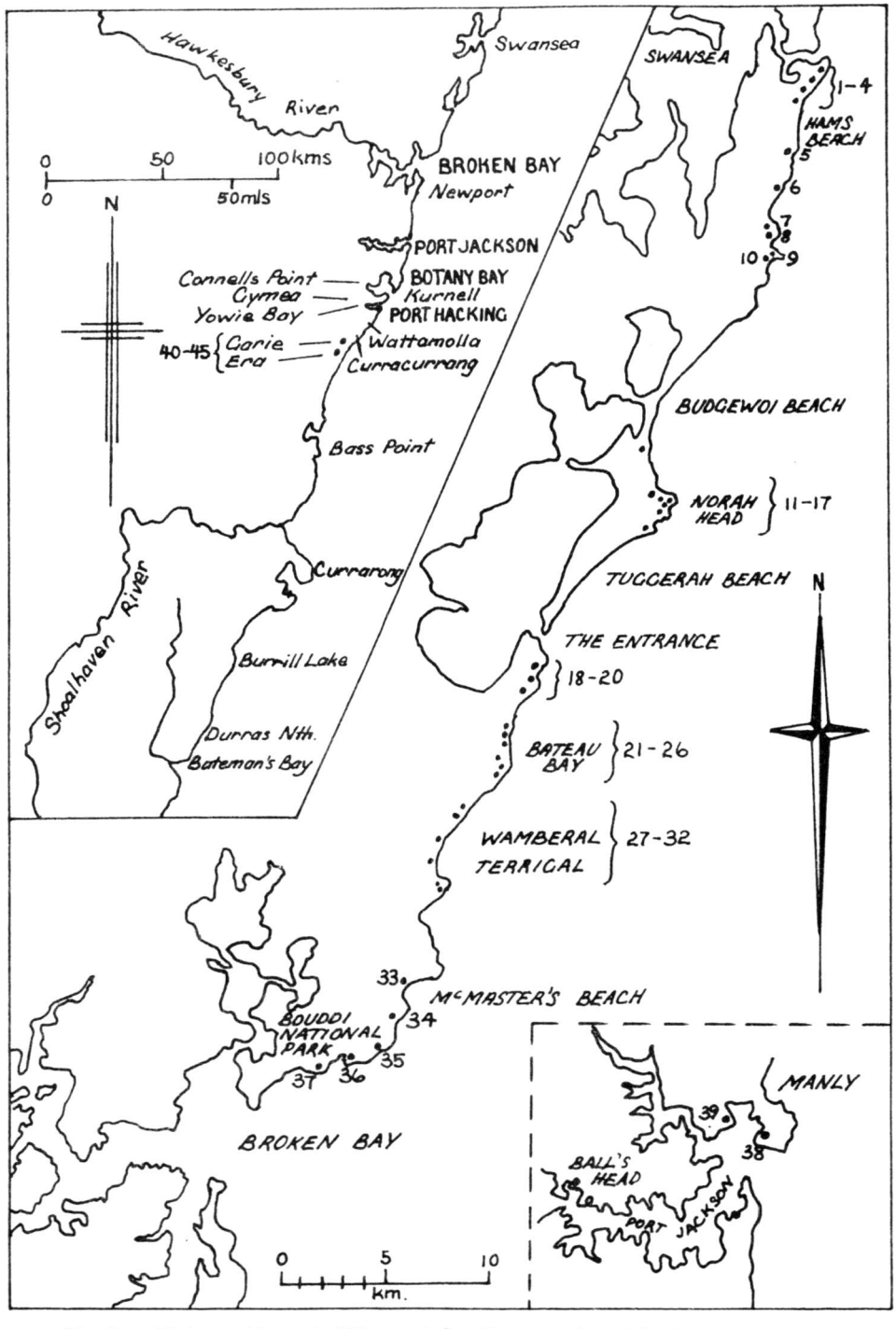

Fig.1 Distribution of NSW coastal sites mentioned in text.
Upper left inset - Central and South Coasts
Lower right inset - Port Jackson (same scale as main map)
Main map - Central Coast (sites numbered as for Table 1)

2 for other comparisons. However the central coast distribution is very uneven. No sites were found along the Budgewoi and Tuggerah Beaches - middens may once have been located among the sand dunes set further back from the beach and now lost to rutile mining (mining destroyed two known middens in the Bouddi National Park, also one at Catherine Hill Bay (Swan 1970:35)), or the long exposed beaches may not have favoured any form of marine exploitation. For the rest, distribution can be illustrated in reference to the main clusters:

Sites 1 - 10 (+ 1)	(northern portion)	.75/km
11 - 17	(Norah Head)	1.13
18 - 26	(Entrance-Bateau Bay)	1.29
34 - 37 (+ 2)	(Bouddi N.P.)	.44

The lower values for the northern and southern extremities would be related to the rugged character of the coastline. The higher values for the central portions illustrate the more favourable combination of alternatine beach and headland, together with extensive rock platforms.

For the south coast middens (Sullivan 1976), factors determining choice of site were seen to be rock type of platform (related to shell fish source), proximity to water, aspect (protection from prevailing south to southeast wind), accessibility of camp to food source, ground surface (sand preferred to rock). For the central coast, rock type is the same throughout, although the conglomerate may be less favourable than sandstone. Water is everywhere close at hand, either as creeks or seepages at the foot of cliffs. Whereas the south coast sites were mostly northeasterly or easterly in aspect, for the central coast the predominant orientations were east (14), southeast (12) and south (6), suggesting that on this part of the coast aspect was incidental to a site chosen on other grounds. In site location, apparently, the chief attraction was beach in close proximity to rock platform or reef.

All stratified occupation material is preserved for us by natural geomorphic processes which not only seal but also modify the archaeological record. The 1972 survey classified coastal middens into beach, dune and cliff-top middens, emphasising the geomorphic formations in which they were incorporated, thus underlining both the limitations and the usefulness of the record. This system was continued in the extended survey (Table 1). The cliff-top middens, in old sand or clay overlying the sandstone cliffs, containing fragmentary shell and occasional pebble tools, did not recur in the extended survey. Dune middens were outnumbered by beach middens. Three beach middens incorporated a quarry/work floor, like the one described in detail at Bateau Bay.

Concerning beach middens, it is worth repeating that they appear as thin horizontal occupation levels, sometimes successively in the one section, in the sea-eroded face of former beaches. These generally stand about 1 m above the present beach and 3 to 4 m above high water level, which raises the possibility that they were formed about the same time by the same geomorphic agents. Many of these sites (e.g. no.34) would be reworked middens according to the criteria proposed by Hughes and Sullivan (1974). Others do not meet these criteria and presumably represent spasmodic occupation alternating with phases of beach formation, which is affected not only be sea action, but also by wind action, erosion from higher slopes, pedogenesis, vegetative consolidation, faunal displacement, etc. Dune sites too, since they are part of a continuing process, can be

Table 1: List of Coastal Sites

No.	Locality	G.R.[1]	Aspect	Midden type	Contents[2]
1	Swansea Heads	678099	E	beach	s,c,f
2		675095	SE	beach	quarry/work floor, s,c,f,t, coal
3	Ham's Beach	673092	SE	dune	3 middens, s,f,c, coal
4		671089	SE	dune	s,f,c, coal
5	Pinney Beach	657052	SE	beach	2 sites, work floor, s,f,c,b,t,e
6	Catherine Hill Bay	650032	S	beach	s,c
7		645014	NE	beach	s,c,f
8	Mooney Beach	644007	SE	beach	work floor, s,c,f,t
9		648996	S	beach	s,c,f,t, coal
10		645996	S	beach	s,f
11	Norah Head	574897	E	dune	s,f
12		577872	E	cliff-top	s
13		583871	N	beach	s,f
14		588868	SE	cliff-top	s, pebble tools at base
15		582863	SE	dune	s,f, many t
16		582858	SE	beach/cliff	s
17		574850	SE	dune	s,f, many t,e
18	The Entrance	511777	E	beach	3 strata, s,f
19		509772	NE	beach	s,f
20		504766	SE	dune	s,c,b,f, many t,e
21	Bateau Bay	495752	E	beach	s,f
22		495748	E	beach	6 strata, s,c,f,t
23		496747	E	cliff-top	s
24		495747	SE	beach	s,c,f

cont'd/

[1] Grid reference for maps of 1:63,360 scale (Lake Macquarie, Gosford and Norahville Broken Bay)

[2] Code: s = shells, c = charcoal, f = primary flakes, t = tools, b = bone, e = excavation potential

Table 1 (continued)

No.	Locality	G.R.[1]	Aspect	Midden type	Contents[2]
25		495733	E	beach	quarry/work floor, pebble t,s,e
26		494730	E	cliff-top	sumatralith *in situ*
27	Wamberal	470703	E	cliff-top	s
28		469702	E	cliff-top	sumatralith *in situ*
29		463695	E	cliff-top	s
30		455689	SE	beach	t
31	Terrigal	457668	NE	cliff-top	s,t
32		458664	S	cliff-top	s
33	McMasters Beach	442615	S	beach	s,c,f
34	Bouddi National Park	426591	E	beach	s,c,b
35		417573	E	shelter	s,c,f,e (deep deposit)
36		403573	W	beach	2 sites, s,c,f
37		387565	S	beach	s,c
38	Spring Cove	295239	N	shelter	s,c,b,f,t, burials, art
39	Reef Beach	279230	NE	beach	s,c,b,f, burials
40	Garie	072795	SE	dune	s, many t
41		064787	SE	beach	s,c
42		064785	SE	beach	s,c
43	Era	057782	SE	dune	s, many t
44		054779	S	beach	s,c
45		054777	E	beach	quarry (?),s

[1] Grid reference for maps of 1:63,360 scale (Lake Macquarie, Gosford and Norahville Broken Bay)

[2] Code: s = shells, c = charcoal, f = primary flakes, t = tools, b = bone, e = excavation potential

Table 2: Density of Coastal Sites

	No. of sites	Distance (km)	No. sites/km	Source
Moreton Bay - ocean frontage	185	123	1.5	Ponosov (estimated for 6 largest islands)
- bay frontage	84	144.5	.58	
North Coast (Qld-Port Macquarie)	>56	435	>.13	McBryde 1974:286-7
Central Coast, NSW	40	79	.51	
Port Hacking	68	48	1.42	Megaw & Wright 1966:fig.6
South Coast (Durras-Bermagui)	86	120	.72	Sullivan 1976:61
Victoria (estimated minimum)	1430	1677	.85	Coutts *et al.* Table 16

Table 3: Projected Number of Sites for Sydney Coast (Box Head - Port Hacking Pt)

	Distance (km)	Estimated density no./km	Estimated no. sites
Port Hacking	48	1.42	68
Botany Bay[1]	128	1.42	182
Port Jackson[1]	240	1.42	340
Broken Bay[1]	610	1.42	866
Ocean frontage[2]	84	1.2 (for 64 km)	77
		.4 (for 20 km)	8
Total	1110		1541

[1] Length of shoreline by courtesy of Maritime Services Board (B. Cole, pers.comm.). Density as for Port Hacking (Table 2)

[2] Estimated from comparable parts of Central Coast: alternating beach and headland (1.2/km)
mostly cliff (.4/km)

stratigraphically sealed and/or reworked by subsequent wind action. In effect this means that each archaeological site has to be judged on its own geomorphic history, and on the greater or less effect of immediate factors in that history, in order to assess the kind of information it can provide.

Faunal Content

Table 4 lists the shell content of some of the sites in this survey (as numbered), compared with other coastal sites. The differences reflect environmental rather than cultural factors. Sites 5, 34 and 35, on the open coast, can be expected to differ from sites 38 and 39, with a harbour setting, but differences between sites 34 and 35, in similar inlets only 2 km apart, are surprising.

Fish remains were not significant, snapper bones being the most common. The left radius of the Australian fur seal, *Arctocephalus pusillus doriferus*, was found at site 5. Seals are also represented at site 20, Wattamolla (Megaw 1974:7-8) and Durras North (Lampert 1966:94-6), but I am not aware of more northerly occurrences.

After the event it was realised that a useful exercise would have been to check if there was any correlation between midden type, faunal content, presence/absence of artefacts, tool types and environmental conditions. For example, some shell middens may lack worked stone altogether. Sites 5 and 20, showing variety in faunal content, also yielded a variety of stone implements. Dune sites are also more varied in their tool content. The presence of only primary flakes at some shell midden sites may suggest their use in dislodging and opening shells.

Stone Artefacts

The largest range of tool types occur on the dune middens at Era and Garie Beaches. They include cores, pebble tools (choppers and steep scrapers), serrated flakes, alternatively flaked tools, hammerstones, scalar cores (fabricators), bondi points, eloueras, geometric microliths, and flakes with edge-trimmed concaves and margins. There was no reason to believe that these sites were occupied over a long period and that such tools were not chronologically associated in the recent past. The small rock shelter at Spring Cove, also presumably recent from the state of preservation of fine shell and bone, lacked large stone tools and backed blades, but included fabricators, eloueras, steep scrapers, bone points, shell fish hooks and stone fish hook files. That these two assemblages represent the range of durable artefacts in the Sydney region in the recent past is confirmed by excavations at Wattamolla (Megaw and Roberts 1974:1-12), Curracurrang (Megaw 1965:202-7; 1966:4-14; 1967:26-30), Kurnell (Megaw 1968: 17-20; Dickson 1974:44-50), Connell's Point (Wade 1967:35-40), Gymea Bay (Megaw and Wright 1966:23-50), Newport (Tracey 1974:25-8) and Yowie Bay (Poiner 1974:25-34). The one qualification to be noted is that the bondi point seems to have been superseded some centuries before European contact.

On the central coast, in common with coastal middens elsewhere, the sites are generally poor in stone tools. Only the work floors 2, 5 and 25, and the dune middens 17 and 20 contained anything like an assemblage. The last two were the only ones to have characteristic items of the Small Tool Tradition: scalar cores (at both) and bondi points (3 at no.17). A

Table 4: The most significant molluscs, in terms of size and frequency (and presumably as food source), in NSW middens*

	Site 5	Site 34	Site 35	Milligans Cave	Newport	Site 38	Site 39	Balls Head	Gymea Bay	Wattamolla	Bass Point	Currarong	Durras North
Cabestana spengleri Spengler's triton	+	+	+		+	+	+			+	3	+	
Charonia rubicunda triton													+
Turbo torquata large turban	+	+		+		+	+			7	2	+	+
Turbo undulata small turban			+			+	+			4		+	2
Haliotis ruber abalone/mutton fish	+	+	+				+			+		+	+
Thais orbita cart-rut shell		+	+				+			5	4	+	3
Nerita atramentosa black nerite		+	+			+	+		+	3		+	5
Saccostrea cucullata Sydney rock oyster			+	+	+	+	+	1	1	+		2	+
Ostrea angasi mud oyster				+	+			4	5				
Anadara trapezia Sydney cockle	+		+	+	1		+	3	2	+			+
Trichomya hirsuta hairy mussel				+	+	+	+	2	3	+		+	
Mytilus planulatus common mussel			+	+						+	1	+	1
Pyrazus ebeninus Hercules club whelk		+		+	2			+		+		1	
Velacumantis australis mud whelk				+	+			+	+	+			
Cellana tramoserica variegated limpet	+	+	+			+	+			1			+
Patellanax peronii scaly limpet	+									2			+
Patelloida alticostata tall-ribbed limpet		+	+				+			+			
Monfortula conoidea cap-shaped limpet							+			+			
Siphonaria sp. air-breathing limpet						+	+	+					
Notoacmea sp. limpet								+					
Chiton sp.		+	+				+	+		+		+	4
Chama sp.				+			+	+	4				
Scutus antipodes black elephant snail	+	+	+							+			+
Austrocochlea constricta lined periwinkle			+				+		+	+		+	+
Austrocochlea concamerata periwinkle								+					
Plebidonax deltoides pipi				+						+		+	+
Circe sugillata circular tapestry shell			+	+			+		+				

* Linnaean names are standardised to current usage at The Australian Museum, Sydney (P. Coleman, pers.comm.). The numbered sites of this survey are compared with Milligans Cave (J. Clegg, pers.comm.) and published sites, listed in N-S order. In the table, digits signify order of predominance, • signifies presence

fish-hook file was found at site 5. Altogether absent were geometric microliths and eloueras.

This bears out Wright's observation that 'the specific implement types of the Bondaian tradition...are characteristic of recent middens only to the south of Newcastle' (1975:20). This general remark, however, needs qualifying: the Clarence River sites 400 km north of Newcastle, including the Wombah midden only 13 km inland, have yielded bondi points, geometric microliths, eloueras and scalar cores (McBryde 1974:168-292, 327); the Kinsella collection from Morna Point, just north of Newcastle, included three bondi points (Swan 1970:31). Swan (*ibid*:67) notes a major change in the composition of coastal surface material at about Port Stephens, a change to greater coarseness as one goes north. Apart from spasmodic occurrences of Bondaian implements, the present survey shows this change taking place on the central coast.

Common throughout but predominating north of Norah Head are large tools made on pebbles (choppers, split-pebble tools, steep scrapers, serrated and alternatively flaked pieces) and generally large primary flakes, with or without retouch. Size is presumably related to the supply of large pebbles of suitable stone occurring freely on the beaches and in the conglomerates of the Hunter region. This was evident from the massive cores and primary flakes (plus fire-split flakes) found at site 5, where the beach is composed mostly of large chert pebbles and the stratified work floor/occupation level is not unduly old (see below).

The quarry/work floor at Bateau Bay and its assemblage of pebble tools were described in the earlier survey (Stockton 1972:22-4). Any of the items can be found singly in association with small artefacts on recent coastal middens, but as an assemblage it was quite distinctive. Of more than 400 certain artefacts, there was not a single backed blade, edge-trimmed flake or scalar core. Common and carefully executed were unifacially trimmed split-pebble tools (sumatraliths) and choppers. The latter sometimes showed flaking in two or three tiers, like the Kangaroo Island choppers (as examined at the Australian Museum). There was evidence of a specialised type described as a pick in the 1972 report. In that report, too, attention was drawn to an unusual technique of primary flaking. Such pebble tools occurred singly elsewhere, either protruding from the base of old sand cliffs, or lying at the foot of the cliffs at Norah Head presumably fallen from the cliff-top middens above.

Burnt coal appeared in the northernmost middens, suggesting the occasional use of coal detached from seams in the cliff face and washed up as large lumps on the shore (as still happens).

Antiquity

Geomorphic context and tool type at the Bateau Bay quarry/work floor and the cliff-top middens raise the possibility that this series of sites is older than the other middens. The Bateau Bay assemblage is embedded in a clayey alluvial fan disgorging from a small valley onto the rock platform, and currently the sea breaking over the platform is eroding the edges of the fan. Hence the deposition of the fan and the tools themselves must date back to a time when the sea was lower than at the present, yet not too distant because decomposed shell is present in the clay. A date in excess of 6000 BP seems to be indicated.

The cliff-top middens may be older still. They are embedded in the base of what were once high old dunes, which may have originally covered the present cliff faces, with their feet and foredunes resting on the present rock platforms. This is suggested not only because it is difficult to see how a sand dune could form at the edge of a cliff, but also because the seaward face is not sloping but vertical, indicating that the dune, after consolidation, had its foot and foredune eroded by the rising sea breaking over the platform. It is possible that these old dunes, together with their shell and tool content, go back to a time when the sea was previously at the present or higher level, allowing for proximity of the sea (for mollusc collection) and for time in which the dunes could be formed, consolidated and eroded.

Shell samples from Bateau Bay and Norah Head have been collected for dating purposes but have yet to be processed. It is hoped the information may contribute to the question of man's earliest occupation of the coast of southeast Australia (Campbell 1972; Lampert and Hughes 1974; Bowdler 1977; Coutts *et al.* 67-8) and to the related discussion of past sea levels (e.g. Thom and Chappell 1975; Gill 1976).

To secure a date for a typical beach midden, an abalone shell was taken from the occupation level of site 2, Swansea Heads, and it registered 1235 ± 95 BP (SUA-514). The sequence in the 1 m high face of the former beach shows:

a) the lower half (like the present beach) consisting of white chert pebbles, that originate from the chert seam prominent in the nearby cliffs,

b) the occupation level at mid-height comprised of charcoal-blackened sand, pebbles, flaked stone, shells and coal,

c) sterile sand to the surface, with occasional pebbles suspended in the sand.

The state of the occupation level and of the sterile sand above showed that the midden had not been reworked since occupation, but that the beach level had risen only by the gradual accretion of materials from the steep slope behind.

Conclusions

Apart from filling an obvious gap in our knowledge of coastal occupation in southeastern Australia, the present survey has implications beyond the area of study:

1. Further indication of Pleistocene presence of man on the coast.
2. Closer specification of technological variation spatially along the coast.
3. The projection of the number of sites along the immense Sydney shoreline from adjacent comparable areas.
4. The apparent general increase, southward, of the density of coastal sites in southeastern Australia, while allowing for greater site density in areas of greater natural advantage.
5. Some methodological contribution to the study of sites which are notoriously unexciting.

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